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Hospital admissions and place of death of residents of care homes receiving specialist healthcare services: protocol for a systematic review

Running head:

Specialist healthcare services for care homes

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Abstract:

Aim: To synthesize the evidence relating to the ability of specialist care home support services to prevent the hospital admission of older care home residents, including hospital admission at the end-of-life.

Design:

Systematic review and narrative synthesis.

Methods:

Ten electronic databases will be searched from 2010 to 31st December, 2018 using pre-determined search terms. All studies of specialist healthcare services to meet care home residents' physical healthcare needs which provide outcome data on hospital admission or place of death compared with usual care will be included. Two reviewers will independently assess studies' eligibility and methodological quality using the Effective Public Health Practice Project Quality Assessment Tool. Data will be extracted by one reviewer and checked by a second according to pre-determined categories. Data will be synthesized in evidence tables and narrative. Funder: National Institute for Health Research School for Social Care Research, November 2016.

Discussion:

Care of older people within care home settings is a key aspect of nursing nationally and internationally. This review will increase understanding of the extent to which different models of specialist healthcare support for care homes are associated with key resident outcomes.

Impact:

Standard healthcare support for care home residents is often inadequate, resulting in avoidable hospital admissions and lack of resident choice as to place of death. Although a range of specialist healthcare services are emerging, little is known about their relative effectiveness. This paper marshalls evidence of relevance to commissioners investing in healthcare provision to care homes to meet NHS targets.

Keywords:

Long-term care facilities; nursing homes; care homes; older people; systematic review; specialist health services; place of death; hospital admissions; outcomes

INTRODUCTION

In recent decades, most high-income countries have sought to shift the balance of care towards the community, enabling older people to 'age in place' (WHO, 2015). Nevertheless, global population aging is predicted to lead to a significant increase in the demand for care homes (variously known as nursing homes, long-term care facilities, residential facilities, aged care facilities and assisted living facilities in different countries) (Kingston et al., 2017; Pickard et al., 2007; WHO, 2015). Projections suggest that over the next thirty years, the number of care home places in countries including the UK, Australia and the US will need to grow by more than 100 per cent (Center to Advance Palliative Care, 2008; Ferris, 2013; Wittenberg, Comas-Herrera, Pickard & Hancock, 2004).

Care home residents are frequently frail with high levels of disability and a complex mix of chronic physical and mental health problems (Boyd, Bowman, Broad & Connolly, 2011; Gordon et al., 2014; Lievesley, Crosby & Bowman, 2011). They are also subject to polypharmacy (Gordon et al. 2014; Vetrano et al., 2014). A 2011 inquiry by the British Geriatrics Society identified dementia, stroke, degenerative neurological conditions, advanced cardio-respiratory disease, cancer and arthritis as the most common conditions experienced by care home residents and noted that these were often accompanied by loss of appetite or difficulty eating and drinking, resulting in malnutrition and dehydration. For many residents the optimum approach is thus end-of-life care, although this population is also highly susceptible to acute illness (BGS, 2011; Dwyer, Gabbe, Stoelwinder & Lowthian, 2014).

Healthcare provision for older care home residents varies from country to country, reflecting different funding incentives, national infrastructures and available resources (Briggs, Robinson, Martin & O'Neill, 2012; Froggatt et al., 2017). In the UK, most

care home residents' medical care is coordinated by General Practitioners (GPs or primary care physicians) few of whom have received special training in the care of older people, or have the time and resources required to provide the individualized approach required (BGS, 2016; Briggs et al., 2012*;* Goldman, 2013)*.* Further, less than a third of the 18,000 care homes are registered to provide nursing (Bowman & Meyer, 2017), and there is no stipulation for care home nursing staff to have any particular expertise in the care of older people (Hayes & Martin, 2004). In contrast with previous decades when older people with chronic ill health were typically cared for by specialist staff in long-stay hospital wards (Carter, 2011), it can thus be difficult for care home staff to access appropriate and timely healthcare support for residents, resulting in the under-detection of potentially treatable conditions, avoidable hospital admissions and a lack of resident choice as to place of death (BGS, 2011; Carter, 2011; Iliffe et al., 2016; NHS England, 2015; Public Health England, 2013). Moreover, this situation is not unique to the UK. Similar concerns have been voiced in many countries, and there have been widespread calls for more specialized models of support (Briggs et al., 2012; McAndrew, Grabowski, Dangi & Young, 2016; Tolson et al., 2011).

Background

In recent years a range of service models have been developed to provide additional healthcare support for care home residents in the UK (Burns & Nair, 2014; Donald et al., 2008; Gordon, 2015). Several of these have sought to enhance standard primary care. In some localities, for example, each care home has been allocated a specific GP (Goldman, 2013; NHS England, 2015); in others, care home specific medical practices deliver primary care for all care home residents; whilst in still others GPs

receive additional payments for activities over and above standard care, including additional reviews of care home residents and regular, scheduled visits (Burns & Nair, 2014; Goldman, 2013; NHS England, 2015).

Other initiatives have sought to create partnerships between primary and secondary care, supplementing and supporting the work of primary care practitioners with input from other professional disciplines (Burns & Nair, 2014). In one initiative, for example, geriatricians held fortnightly medical advisory meetings with GPs and community pharmacists, and offered daily telephone advice (Lisk et al., 2012), whilst the literature contains several examples of dedicated multidisciplinary care home support teams, involving a mix of nursing, medical and other practitioners (Clarkson, Hays, Tucker S, Paddock & Challis, 2018; Hayes & Martin, 2004; Joseph Rowntree Foundation, 2008). In light of concerns about residents' complex drug regimes and high levels of medication errors within care homes (Ferrah, Lovell & Ibrahim, 2017; Oscanoa, Lizaraso & Carvajal, 2017), further initiatives have explored the potential benefits of pharmacist-led services to oversee the management of residents' medication (Crotty, 2007; Furniss et al., 2000). Whilst the majority of initiatives undertake the specialist assessment of care home residents and provide advice and support for staff, a minority focus solely on upskilling care home staff (Butler, 1997; Clarkson et al., 2018; Lewis & Jones, 2002).

Similar initiatives have been trialled internationally (Clarkson et al., 2018). Pain and colleagues (2014), for example, described an in-house model of general practice in Australia whereby a core group of GPs were rostered to provide weekly sessional clinics in a care home. As part of the Evercare demonstration programme in the US, nurse practitioners assessed and managed residents on an ongoing basis, supplementing the support provided by primary care practitioners (Kane, Keckhafer,

Flood, Bershadsky & Siadaty, 2003), and comparable services have been described in Canada (Klaasen, Lamont & Krishnan, 2009; McAiney et al., 2008). Pharmacy-led services have been reported in countries including Spain, Australia and the US (Crotty et al., 2004; Maack, Miller, Johnson & Dewey, 2008; Martínez, Mondéjar, Gómez & Torres, 1995). Other initiatives, in countries including Hong Kong, Singapore and Sweden, have explored the use of telemedicine to deliver specialist geriatric services to nursing home residents via videoconferencing (Hofmeyer et al., 2016; Hui & Woo, 2002; Janardhanan, Leow, Chio, Kim & Soh, 2008; Sävenstedt, Bucht, Norberg & Sandman, 2002; Wade, Whittaker & Hamlyn, 2015), whilst some countries have developed a different service model, with specialist physicians employed in care homes. In The Netherlands, for example, specialist nursing home medicine doctors (recently renamed elderly care medicine doctors) constitute the fifth largest medical speciality in the country and undertake a three year specialist training programme (van Zuthem & Harting, 2011).

A number of core activities for specialist healthcare support services for care homes have been identified. These include the comprehensive assessment of new residents; regular, structured multidimensional reviews; medication reviews; falls prevention; and advance care planning and end-of-life care (Burns & Nair, 2014; Joseph Rowntree Foundation, 2008). There is considerable congruence in the outcomes such interventions seek to achieve, not least of which are a reduction in the number of hospital admissions, including admissions at the end of life. These have been identified as indicators of good quality care for care home residents (Dwyer et al., 2014; Grabowski, Stewart, Broderick & Coots, 2008). Although the rate of care home residents admitted to hospital varies between studies, it is often high. In a review by Grabowski and colleagues (2008), the rate of admissions from nursing homes ranged from nine to 59 per cent across studies. Furthermore, a recent UK study found care

home residents had 40 to 50 per cent more emergency admissions than the general population aged 75 plus (Smith, Sherlaw-Johnson, Ariti & Bardsley, 2015). Although admission to hospital for acute illness or injury may be clinically appropriate, it is associated with a number of adverse effects, including a deterioration of functioning, falls, confusion and infection (Agotnes, Jacobsen, Harrington & Petersen, 2016; Arendts, Jan, Beck & Howard, 2017; Dwyer et al., 2014; McAndrew et al*.,* 2016). Moreover, research indicates that as many as 40 per cent of care home residents who die in hospital do so within 24 hours of admission, suggesting that many of these admissions may be inappropriate (Ong, Sabanathan, Potter & Myint, 2011).

Despite general agreement on the need to reduce avoidable hospital admissions, including admissions at the end-of-life, the extent to which specialist healthcare support services can achieve such outcomes is not clear. To date, most systematic reviews appear to have focused on the effectiveness of specific activities, such as optimising prescribing (Alldred, Kennedy, Hughes, Chen & Miller, 2016; Forsetlund, Eike, Gjerberg & Vist, 2011; Thiruchelvam, Hasan, Wong & Kairuz, 2017; Wallerstedt, Kindblom, Nylén, Samuelsson & Strandell, 2014) or palliative care interventions (Hall *et al*., 2011), both of which appear to show promise, although the included studies are generally of poor quality and have heterogeneous designs and interventions. In contrast, other reviews have focused on a wider range of interventions designed to achieve particular outcomes. For example, Graverholt and colleagues' 2014 review of interventions to reduce the acute hospital admission of nursing home residents included interventions ranging from standardising clinical practice, to input from specialist geriatric services to vaccination for influenza.

To date, reviews of specialist healthcare services for care homes have been few in number and inconclusive. One evidence briefing on interventions to reduce unplanned

admissions failed to identify any systematic reviews of community geriatrician services for residents, but highlighted some promising case reports of geriatrician and multidisciplinary initiatives, although there was no systematic search for these (Centre for Reviews and Dissemination, 2015). A systematic assessment of the evidence for integrated working between care homes and healthcare staff concluded that the heterogeneity of interventions, methodology (quantitative and qualitative) and outcomes precluded any robust conclusions about the outcomes of different approaches (Davies *et al*., 2011). Finally, a systematic evidence review UK literature on partnership working between GPs, other healthcare professionals and care homes concluded there was little robust evidence on resident outcomes from studies comparing these models to usual GP care (Goldman, 2013).

In summary, to date most reviews have focused on particular types of intervention or specific outcomes, with less attention given to the way that specialist input is organized and structured in terms of the relative effectiveness (and cost-effectiveness) of different practice arrangements. There is then a need for an international comprehensive systematic review which takes a systems perspective and compares the effectiveness of different ways of working in reducing hospital admissions, including admissions at the end-of-life. An increased understanding of the relative effectiveness of different models of care home support will enable service planners and commissioners to make better informed decisions about the form and content of specialist healthcare support for care home residents.

REVIEW

Aims

This review builds on an earlier systematic review of the organisation, activities and responsibilities of specialist healthcare services to care homes. Services were classified into different models of support and examples were given of their relative effectiveness with respect to a wide range of resident and process outcomes (Clarkson et al., 2018). The current review updates the earlier review and develops it further by systematically identifying, appraising and synthesizing the available evidence on two specific outcomes - the ability of specialist care home services to prevent the inappropriate hospital admission of older, long-term care home residents and to enable them to remain in the care home at the end-of-life (as compared with 'usual care'). The secondary aims are to establish whether identifiable subgroups of services produce different resident outcomes; to explore the extent to which descriptions of 'usual' or 'standard' care vary; and to identify service costs. This work forms part of a wider study of the effective provision of healthcare support to care homes funded by the National Institute for Health Research School for Social Care Research (Grant ref C088/CM/UMDC-P113).

Design

A systematic literature review and narrative synthesis will be undertaken following established guidance (CRD, 2009; Rutter *et al*., 2010). This paper details the protocol for the review in accordance with the PRISMA-P (protocol) statement (Moher *et al*., 2015; Shamseer *et al*., 2015). The protocol was registered with the International Prospective Register of Systematic Reviews (PROSPERO) on 09/11/2017 and was last updated on 01.03.2018 (Reference CRD42017081161).

Inclusion and exclusion criteria

Studies will be selected according to the criteria below.

Types of studies:

Include: All empirical research studies and service descriptions published in peer-reviewed journals which provide comparative quantitative data on our primary outcomes e.g. randomized controlled trials (RCTs), cluster randomized trials, controlled (non-randomized) clinical trials or cluster trials, and controlled before and after studies.

Exclude: Commentaries, opinion pieces and descriptive articles without relevant empirical data.

Types of settings:

Include: Care homes for older people with or without nursing, including care homes for older people with dementia.

Exclude: Studies concerned solely with the provision of care in hospital settings, individuals' own homes or other community settings.

Types of participants:

Include: Older people (with or without dementia) permanently resident in care homes. Specifically, people aged 60 or over and samples with a mean/median age of 69 plus where age is reported, and samples described as samples of older people where age is not reported. Studies encompassing both older and younger, or long and short-stay care home residents will be included if data for permanent older residents are reported separately.

Exclude: Studies of younger and short-stay care home residents only.

Types of interventions and comparisons:

Include: All studies of specialist services specifically designed to address the physical healthcare needs of older long-stay care home residents. This will include enhanced General Practitioner services, dedicated mono or multidisciplinary care home support teams, pharmacist-led services and specialist input from palliative care teams, including telecare support services. Studies of specialist care home physicians or other practitioners embedded in / employed by care homes will also be included.
Exclude: Services/interventions specifically designed to address the care home residents' mental health needs.

Where information is available, the service or intervention will be compared with 'standard' or 'usual' care as described by the author/s. Alternatively, comparisons will be made with the service provided before the introduction of the service/intervention.

Types of outcomes:
Include: Studies that report information on hospital admission and/or place of resident death (e.g. care home or hospital). Hospital admission data may relate to planned or unplanned admissions or readmissions but these outcomes will be reported separately.
Exclude: Studies that do not contain data on either of the above outcomes.

For studies that meet all the inclusion criteria, information will also be collected on service costs where reported.

Search methods

The search strategy will replicate and build on the strategy used in the aforementioned earlier review of studies of specialist healthcare services provided to care homes published between 1990 and 2010 (Clarkson et al., 2018). As such it will

synthesize the evidence from the point at which responsibility for the placement of people in care homes was transferred to adult social care (DH, 1989). First, new (post 2010) related systematic reviews will be identified by searching the Cochrane Database of Systematic Reviews (CDSR), the Database of Abstracts of Reviews and Effectiveness (DARE), the Health Technology Assessment Database, the National Health Service Economic Evaluation Database, Social Care Online, PubMed and PROSPERO.

Second, new electronic searches for relevant studies will be undertaken in the following databases from 2010 onwards: AgeInfo, CINAHL Plus, EMBASE (incorporating Medline), HMIC, PubMed, PsycINFO, Social Care Online, the CDSR, The Joanna Briggs Foundation (JBF) and Web of Science. Auto-alerts will be established until the study end (31st December, 2018).

A specific search strategy will be developed for each database using medical subject headings (MeSH) and text words relating to four search blocks. These have been developed by the research team and reviewed by staff in the University of Manchester Library's Systematic Review System service who deemed them comprehensive and robust. The first three blocks will mirror those used in the original review i.e. care homes, healthcare and older people (updated to reflect any newly identified terms), whilst the fourth relates to the outcomes of interest i.e. hospital admission and place of death. The terms within each search block will be combined using the OR function and the blocks will be combined with the AND function. All searches will be limited to the English language, but no geographical restrictions will be applied. An example search strategy is provided in Supplementary File 1.

Additional publications will be identified by scrutinising the reference lists of related systematic reviews, included studies and other relevant publications, and a cited reference search of the included studies will be undertaken in Web of Science. A list of the selected papers will be sent to care home experts identified by the research team with a view to identifying any omissions. Where required, authors of relevant studies will be contacted to clarify published data or seek unpublished results.

Study selection

The study selection process will have three stages, mirroring the initial review (Clarkson et al., 2018). First, the title, abstract and publication details (journal, year of publication and author list) of the records retrieved via the electronic searches will be downloaded to an Excel worksheet and their author lists and titles scanned in ascending order to identify and remove duplicates.

Second, a bespoke screening tool based on the above inclusion/exclusion criteria will be developed, and the title and abstracts of at least 100 randomly selected records will be screened by three reviewers (DB, ST and another) together in order to identify those publications that clearly do not meet the study inclusion criteria (e.g. which do not concern the healthcare of care home residents). The remaining references will then be screened by two reviewers independently (DB and ST or another). Any discrepancies will be resolved through discussion or appeal to a third reviewer, and the reasons for any exclusions will be recorded.

Third, the full text of all the newly identified publications that appear to meet the inclusion criteria or about which there is uncertainty, plus the references identified in the initial review (Clarkson et al., 2018), will be read by two independent reviewers (DB and ST) to establish whether they meet the full study inclusion criteria. Any

discrepancies will again be resolved through discussion between the reviewers or appeal to the wider study team, and reasons for exclusions will be recorded. Included studies will be given a unique identification (ID) number and related publications arising from the same empirical study will be tagged to avoid over counting or inflation of studies.

Data extraction

A specially designed data extraction form will be developed to systematically extract information on studies' ID, aims, design, methods, participants, interventions/ services, comparison interventions/services and outcomes, including the results of any statistical comparisons or tests. Further, each intervention/service will be classified according to two taxonomies of specialist care home support services developed by the research team from a national survey of healthcare support for care homes (Challis, Hays, Clarkson & Tucker, 2013). The contents of the form will be tested and refined on a sample of five studies by two review authors (DB and ST) before full data extraction commences.

Two reviewers will be involved in the data extraction process. One researcher (DB) will extract data from each eligible included study and a second reviewer (ST) will check the data entry for accuracy, consistency and agreement. Missing information will be sought from corresponding authors wherever possible. Any disagreements will be resolved by discussion or by appeal to a third reviewer. Where multiple reports are identified from the same study, information extracted from individual publications will subsequently be combined into a single study record and study authors will be contacted to resolve any inconsistencies. For those publications identified in the original review (Clarkson et al., 2018), information will only be extracted on the newly added variables (primarily those relating to studies' outcomes).

Quality appraisal

The methodological quality of the studies detailed in the included papers will be independently assessed by two reviewers (DB and ST) using the Effective Public Health Practice Project (EPHPP) Quality Assessment Tool (Thomas *et al*., 2002). This generic tool is considered suitable for the appraisal of a wide range of quantitative studies and covers six domains, each of which is rated as strong, moderate or weak: selection bias; study design; confounders; blinding; data collection method; and withdrawals and dropouts. Each study is then allocated a global rating - strong, moderate or weak - depending on the number of domains assessed as weak (strong – no weak rating; moderate – one weak rating; weak – two or more weak ratings) (Thomas *et al*., 2002; Jackson & Waters, 2005; Armijo-Olivo *et al*., 2012). Where two or more publications relate to a single study, these will be considered together, producing a single global rating for each study. Any disagreements between reviewers will be resolved through discussion or by appeal to a third reviewer.

Data synthesis

It is anticipated that the included studies will vary significantly in type and method, precluding the opportunity for meta analyses, although if possible and where data lends itself, this would be performed. A pragmatic, narrative summary of the evidence relating to the primary and secondary study outcomes is therefore planned. Where multiple papers have reported data from the same study, information will be tabulated from each citation into one record. Evidence will be grouped according to the type of outcome assessed. Information on the effectiveness of specialist healthcare services for care homes to i/ prevent hospital admissions and ii/ enable care home residents to remain in the care home at the end-of-life (the main outcomes

of concern) will be presented in both tables and text. Service cost information (where available) and descriptions of standard or usual care will be reported only within the tables, and the extent to which identifiable subgroups of services produce different resident outcomes will be explored only in the text. Whilst the tables will report information from all included studies, the narrative summary and discussion will give more weight to studies considered of moderate or strong methodological quality, with any references to studies given a low quality rating highlighted with the superscript *.

Ethical considerations

This study involves a review of secondary data from primary research studies. As such, there are no ethical issues of concern.

Validity and reliability

This protocol has been developed in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses checklist (Moher *et al*., 2015; Shamseer *et al*., 2015) and includes several measures to enhance the validity and rigour of the review (CRD, 2009; Rutter *et al*., 2010):

- Searches will be undertaken in a broad range of databases;
- Specific search strategies will be developed for each database with the help of a specialist systematic review team;
- Study selection will be undertaken by two reviewers independently, and pilot testing will be undertaken to ensure that inclusion/exclusion criteria are consistently applied;
- Study authors will be contacted for missing data and to clarify any ambiguities;

- Quality ratings will be undertaken by two reviewers independently using a recognized quality checklist (the EPHPP); and
- Data will be reported following the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) guidelines (Shamseer *et al*., 2015).

DISCUSSION

Care provided for older people in care homes is predominantly undertaken by qualified nurses, or by nursing assistants or health or social care assistants under their leadership and management, whilst experienced nurse practitioners are key members of many specialist care home support services. As such, care of older people within care home settings, its delivery, effectiveness, quality assurance and monitoring is a key aspect of nursing nationally and internationally.

This review is designed to increase understanding of the extent to which different models of specialist healthcare support for care homes which seek to address the physical healthcare needs of older long-stay care home residents are associated with a reduction in hospital admissions, including hospital admissions at the end-of-life. As such it is anticipated that it will add significantly to the existing knowledge base about emergent models of support for care homes. In particular, it will yield information with direct implications for health and social care planners and commissioners seeking to promote arrangements which facilitate the delivery of timely and appropriate healthcare services for care home residents internationally, and the more efficient use of acute hospital beds. These are major policy objectives in many high income countries (Agotnes *et al*., 2016; Tolson *et al*., 2011).

Limitations

Preliminary searches have identified three potential difficulties in performing the review. First, a lack of detail in the description of the intervention or outcomes of certain studies may lead to their being inadvertently excluded. In order to mitigate this, wherever possible the authors will contact the studies' authors to clarify their in/exclusion. Second, a lack of consistency in different studies' classification of hospitalizations may make it difficult to compare different studies' findings. Maximum detail will thus be extracted about studies' outcomes, with a view to providing the necessary contextual detail in the write-up. Third, it may be that only a small number of studies provide evidence on residents' place of death. In this scenario the review will establish the case for more specific research in this area in addition to that identified from the overall review.

References

Agotnes G., Jacobsen F.F., Harrington C. & Petersen K.A. (2016). A critical review of research on hospitalization from nursing homes; What is missing? *Ageing International* **41**, 3-16.

Alldred D.P., Kennedy M.-C., Hughes C., Chen T.F & Miller P. (2016). Interventions to optimise prescribing for older people in care homes. *The Cochrane Database of Systematic Reviews.* Available at: http://cochranelibrary-wiley.com/doi/10.1002/14651858.CD009095.pub3/full (Last accessed 7th August, 2018).

Arendts G., Jan S., Beck M.J. & Howard, K. (2017). Preferences for the emergency department or alternatives for older people in aged care: A discrete choice experiment. *Age and Ageing* **46**, 124-129.

Armijo-Olivo S., Stiles C.R., Hagen N.A., Biondo P.D. & Cummings G.C. (2012). Assessment of study quality for systematic reviews: A comparison of the Cochrane Collaboration Risk of Bias Tool and the Effective Public Health Practice Project Quality Assessment Tool: methodological research. *Journal of Evaluation in Clinical Practice* **18,** 12-18.

Bowman C. & Meyer J. (2017). Care home leadership: action is needed. *Age and Ageing* **46**, 534–535.

Boyd M., Bowman C., Broad J.B. & Connolly M.J. (2011). International comparison of long term care resident dependency across four countries (1998–2009): A descriptive study. *Australasian Journal on Ageing* **31**, 233–40.

Briggs R., Robinson S., Martin F. & O'Neill D. (2012). Standards of medical care for nursing home residents in Europe. *European Geriatric Medicine* **3**, 365–367.

British Geriatrics Society (2011). *Quest for Quality: An Inquiry into the Quality of Healthcare Support for Older People in Care Homes: A Call for Leadership, Partnership and Improvement*. British Geriatrics Society, London.

British Geriatrics Society (2016). *Guidance on commissioning and providing healthcare services across the UK (revised).* British Geriatrics Society, London.

Burns E. & Nair S. (2014). New horizons in care home medicine. *Age and Ageing* **43**, 2-7.

Butler A. (1997). Specialist nursing for residential and nursing homes. *Registered Homes*, 2 July, 29-30.

Carter C. (2011). *Failing the frail: A chaotic approach to commissioning healthcare services for care homes.* British Geriatrics Society, London.

Center to Advance Palliative Care (2008). Improving Palliative Care in Nursing Homes. Available at: https://media.capc.org/filer_public/95/b8/95b84a49-7151-427d-be72-200b634eed5b/3123_1606_nursinghomereport-rev.pdf (Last accessed 7th August, 2018).

Centre for Reviews and Dissemination (2009). *Systematic reviews. CRD's guidance for undertaking reviews in health care*. Available at: http://www.york.ac.uk/crd/guidance/ (Last accessed 7th August, 2018).

Centre for Reviews and Dissemination (2014). *Interventions to reduce unplanned admissions from care home settings.* University of York, York.

Challis D., Hays R., Clarkson P. & Tucker S. (2013). *Specialist Healthcare Support Services to Care Homes. Final Report of a Project.* PSSRU, University of Manchester, Manchester.

Clarkson P., Hays R., Tucker S., Paddock K. & Challis D. (2018). Healthcare support to older residents of care homes: A systematic review of specialist services. *Quality in Ageing and Older Adults* **19**, 54-84.

Crotty, S. (2007). Measuring the impact of medication review in care homes with nursing facilities. *Pharmacy in Practice* **17**, 206-210.

Crotty M., Halbert J., Rowett D., Giles L., Birks R., Williams H. & Whitehead C. 2004. An outreach geriatric medication advisory service in residential aged care: A randomised controlled trial of case conferencing. *Age and Ageing* **33**, 612-617.

Davies S.L., Goodman C., Bunn F., Victor C., Dickinson A., Iliffe S., Gage H., Martin W. & Froggatt K. (2011). A systematic review of integrated working between care homes and health care services. *BMC Health Services Research* **11**, 320.

Department of Health. (1989). *Caring for People, Community Care in the Next Decade and Beyond*. HMSO, London.

Donald I.P., Gladman J., Conroy S., Vernon M., Kendrick E. & Burns, E. (2008). Care home medicine in the UK – in from the cold, *Age and Ageing*, **37**(6), 618-620.

Dwyer R., Gabbe B., Stoelwinder J.U. & Lowthian J. (2014). A systematic review of outcomes following emergency transfer to hospital for residents of aged care facilities. *Age and Ageing* **43**, 759-766.

Ferrah N., Lovell J.J. & Ibrahim J.E. (2017). Systematic review of the prevalence of medication errors resulting in hospitalization and death of nursing home residents. *Journal of the American Geriatrics Society* **65**, 433-442.

Ferris L. (2013). Reforming Australia's aged care system: are we there yet? Available at: https://www.aph.gov.au/About_Parliament/Parliamentary_Departments/Parliamentary_Library/pubs/BriefingBook44p/AgedCare (Last accessed 7th August, 2018.)

Forsetlund L., Eike M.C., Gjerberg E. & Vist G.E. (2011). Effect of interventions to reduce potentially inappropriate use of drugs in nursing homes: A systematic review of randomised controlled trials. *BMC Geriatrics* **11**, 16.

Froggatt K., Payne S., Morbey H., Edwards M., Finne-Soveri H., Gambassi G., Szczerbińska K., Van de Block L. & PACE (2017). Palliative Care Development in European Care Homes and Nursing Homes: Application of a Typology of Implementation. *Journal of the American Medical Directors Association* **18**, 550.e7-550.e14.

Furniss L., Burns A., Lloyd Craig S.K., Scobie S., Cooke J. & Faragher B. (2000). Effects of a pharmacist's medication review in nursing homes: Randomised controlled trial. *British Journal of Psychiatry* **176**, 563-567.

Goldman R. (2013). *Evidence review on partnership working between GPs, care home residents and care homes*. Social Care Institute for Excellence, London.

Gordon A.L. (2015). What is the case for care home medicine? The geriatrician's perspective. *Journal of the Royal College of Physicians of Edinburgh* **45**, 148–153.

Gordon A.L., Franklin M., Bradshaw L., Logan P., Elliott R. & Gladman J.R.F. (2014). Health status of UK care home residents: A cohort study. Age and Ageing **43**, 97-103.

Grabowski D.C., Stewart K.A., Broderick S.M. & Coots L.A. (2008). Predictors of nursing home hospitalization: A review of the literature. *Medical care research and review* **65,** 3-39.

Graverholt B., Forsetlund L. & Jamtvedt G. (2014). Reducing hospital admissions from nursing homes: A systematic review. *BMC Health Services Research* **14**, 36.

Hall S., Kolliakou A., Petkova H., Froggatt K & Higginson I.J. (2011). Interventions for improving palliative care for older people living in nursing care homes. *The Cochrane Database of Systematic Reviews.* Available at: http://cochranelibrary-wiley.com/doi/10.1002/14651858.CD007132.pub2/abstract (Last accessed 7th August, 2018.)

Hayes N. & Martin F. (2004). Supporting care homes: The older people's specialist nurse. *British Journal of Nursing* **13**(21).

Hofmeyer J., Leider J.P., Satorius J., Tanenbaum E., Basel D. & Knudson A. (2016). Implementation of Telemedicine Consultation to Assess Unplanned Transfers in Rural Long-Term Care Facilities, 2012-2015: A Pilot Study. *Journal of the American Medical Directors Association* **17**, 1006-1010.

Hui E. & Woo J. (2002). Telehealth for older patients: The Hong Kong experience. *Journal of Telemedicine and Telecare* **8**, Suppl 2, 39-41.

Iliffe S., Davies S.L., Gordon A.L., Schneider J., Dening T., Bowman, C., Gage H., Martin F.C., Gladman J.R., Victor C., Meyer J. & Goodman, C. (2016). Provision of NHS generalist and specialist services to care homes in England: Review of surveys. *Primary Health Care Research and Development* **17**, 122-137.

Jackson N. & Waters E. (2005). Criteria for the systematic review of health promotion and public health interventions. *Health Promotion International* **20**, 367–374.

Janardhanan L., Leow Y.H., Chio M.T.W., Kim Y. & Soh C.B. (2008). Experience with the implementation of a web-based teledermatology system in a nursing home in Singapore. *Journal of Telemedicine and Telecare* **14**, 404-9.

Joseph Rowntree Foundation (2008). *Providing Nursing Support Within Residential Care Homes. Available at*: https://www.jrf.org.uk/report/providing-nursing-support-within-residential-care-homes (Last accessed 7th August, 2018.)

Kane R.L., Keckhafer G., Flood S., Bershadsky B. & Siadaty M.S. (2003). The effect of Evercare on hospital use. *Journal of the American Geriatrics Society* **51**, 1427-1434.

Kingston A., Wohland P., Wittenberg R., Robinson L., Brayne C., Matthews F.E. & Jagger C. on behalf of the Cognitive Function and Ageing Studies collaboration (2017). Is late-life dependency increasing or not? A comparison of the Cognitive Function and Ageing Studies (CFAS). *Lancet* **390**, 1676-1684

Klaasen K., Lamont L. & Krishnan P. (2009). Setting a new standard of care in nursing homes. *The Canadian nurse* **105**(9), 24-30.

Lewis F. & Jones A. (2002). A support initiative for nursing homes. *Nursing Times* **98**, 39-40.

Lievesley N., Crosby G. & Bowman C. (2011). *The Changing Role of Care Homes*. BUPA and Centre for Policy on Ageing, London.

Lisk R., Yeong K., Nasim A., Baxter M., Mandal B., Nari Raad. & Dhakam Z. (2012). Geriatrician input into nursing homes reduces emergency hospital admissions. *Archives of Gerontology and Geriatrics* **55**, 331-317.

Maack B., Miller D.R., Johnson T. & Dewey M. (2008). Economic impact of a pharmacy resident in an assisted living facility-based medication therapy management program. *Annals of Pharmacotherapy* **42**, 1613-1620.

Martínez M., Mondéjar D., Gómez I. & Torres J. (1995). Drug use within a private nursing home for the elderly in Spain: A clinical therapeutic review. *Journal of Geriatric Drug Therapy* **9**, 59-66.

McAiney C.A., Haughton D., Jennings J., Farr D., Hillier L. & Morden, P. (2008). A unique practice model for Nurse Practitioners in long-term care homes. *Journal of Advanced Nursing* **62**, 562-571.

McAndrew R.M., Grabowski D.C., Dangi A. & Young G.J. (2016) Prevalence and patterns of potentially avoidable hospitalizations in the US long-term care setting. *International Journal for Quality in Health Care* **23**, 104-109.

Moher D., Shamseer L., Clarke M., Ghersi D., Liberati A., Petticrew M., Shekelles P., Stewart L.A. & PRISMA-P Group (2015). Preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) 2015 statement. *Systematic Reviews* **4**, 1.

NHS England (2015). *Quick guide: Clinical input into care homes.* Available at: https://www.nhs.uk/NHSEngland/keogh-review/Documents/quick-guides/Quick-Guide-clinical-input-to-care-homes.pdf (Last accessed 7th August, 2018.)

Ong A.C., Sabanathan K., Potter J.F. & Myint P.K. (2011). High mortality of older patients admitted to hospital from care homes and insight into potential interventions to reduce hospital admissions from care homes: The Norfolk experience. *Archives of Gerontology and Geriatrics* **53**, 316–319.

Oscanoa T.J., Lizaraso F. & Carvajal A. (2017). Hospital admissions due to adverse drug reactions in the elderly. A meta-analysis. *European Journal of Clinical Pharmacology* **73**, 759-770.

Pain T., Stainkey L. & Chapman S. (2014). AgedCare+GP: description and evaluation of an in-house model of general practice in a residential aged-care facility. *Australian Journal of Primary Health* **20**, 224-227.

Pickard L., Comas-Herrera A., Costa-Font J., Gori C., di Maio A., Patxot C., Pozzi A., Rothgang A. & Wittenberg R. (2007) Modelling an entitlement to long-term care services for older people in Europe: projections for long-term care expenditure to 2050. *Journal of European Social Policy* **17***,* 33-48.

Public Health England (2013). What we know now 2013. *New information collated by the National End of Life Care Intelligence Network*. Available at: http://www.endoflifecare-intelligence.org.uk/resources/publications/what_we_know_now_2013 (Last accessed 7th August, 2018.)

Rutter D., Francis J., Coren E. & Fisher M. (2010). *SCIE systematic research reviews: Guidelines*, *2nd edition*. Social Care Institute for Excellence, London.

Sävenstedt S., Bucht G., Norberg L. & Sandman P.O. (2002). Nurse-doctor interaction in teleconsultations between a hospital and a geriatric nursing home. *Journal of Telemedicine and Telecare*, **8**, 11-18.

Shamseer L., Moher D., Clarke M., Ghersi D., Liberati A., Petticrew M., Shekelle P., Stewart L.A. & the PRISMA-P Group (2015). Preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) 2015: Elaboration and explanation. *British Medical Journal* **349**, g7647.

Smith P, Sherlaw-Johnson C, Ariti C. & Bardsley M. (2015). *QualityWatch. Focus on: Hospital admissions from care homes*. Health Foundation & Nuffield Trust, London.

Thiruchelvam K., Hasan S.S., Wong P.S. & Kairuz T. (2017). Residential aged care medication review to improve the quality of medication use: A systematic review. *Journal of the American Medical Directors Association* **18**, e1-187.

Thomas B.H., Ciliska D., Dobbins M. & Micucci S. (2004). A process for systematically reviewing the literature: Providing the research evidence for public health nursing interventions. *Worldviews on Evidence-Based Nursing* **1**, 176-184.
1(3):176-184

Tolson D., Rolland Y., Andrieu S., Aquino J.P., Beard J., Benetos A., Berrut G., Coll-Planas L., Dong B., Forette F., Franco A., Franzoni S., Salvà A., Swagerty D, Trabucchi M, Vellas B, Volicer L, Morley JE; The International Association of Gerontology and Geriatrics/World Health Organization/Society Française de Gérontologie et de Gériatrie Task Force (2011) International association of gerontology and geriatrics: A global agenda for clinical research and quality of care in nursing homes. *Journal of the American Medical Directors Association* **12**, 184-189.

Van Zuthem E. & Hartig J (2011). Elderly care medicine: A valuable speciality in an aging society. *Global Medicine* **13,** 15-17.

Vetrano D.L., Tosato M., Colloca G., Topinkova E., Fialova D., Gindin J., van der Roest H.G., Landi F., Liperoti R., Bernabei R., Onder G, SHELTER study (2013). Polypharmacy in nursing home residents with severe cognitive impairment: results from the SHELTER Study. *Alzheimer's & Dementia* **9**, 587-593.

Wallerstedt S.M., Kindblom J.M., Nylén K., Samuelsson O. & Strandell A. (2014) Medication reviews for nursing home residents to reduce mortality and hospitalization:

Systematic review and meta-analysis. *British Journal of Clinical Pharmacology* **78**, 488-497.

Wittenberg R., Comas-Herrera A., Pickard L. & Hancock R. (2004) *Future Demand for Long-term Care in the UK. A summary of projections of long-term care finance for older people to 2051.* Joseph Rowntree Foundation, York.

Wade V., Whittaker F. & Hamlyn J. (2015). An evaluation of the benefits and challenges of video consulting between general practitioners and residential aged care facilities. *Journal of Telemedicine and Telecare* **21**, 490-493.

World Health Organization (2015). *World Report on Ageing and Health.,* WHO Press: Geneva.

Author contributions

DC is the guarantor. All authors contributed to the development of the selection criteria, the quality assessment strategy and the data extraction protocol. DB developed the search strategy with comment provided by all authors/ reviewers. ST drafted the manuscript. All authors read, provided feedback on and approved the final manuscript.

Supplementary File 1. Search strategy for EMBASE.

1. institutional care.tw.
2. residential care.tw.
3. residential facilit*.tw.
4. nursing facilit*.tw.
5. health service facilit*.tw.
6. assisted living facilit*.tw.
7. extended care facilit*.tw.
8. aged care facilit*.tw.
9. care home*.tw.
10. old age home*.tw.
11. nursing home*.tw.
12. residential home*.tw.
13. care-and-attention home*.tw.
14. dual registered home*.tw.
15. long term care facilit*.tw.
16. long*term care facilit*.tw.
17. long term institution* care.tw.
18. long*term institution* care.tw.
19. hostel*.tw.
20. exp NURSING HOME/
21. (physical adj3 health).tw.
22. (medical adj3 care).tw.
23. (medical adj3 service*).tw.
24. (medical adj3 assessment*).tw.
25. (geriatric* adj3 care).tw.
26. (geriatric* adj3 service*).tw.
27. (geriatric* adj3 assessment*).tw.
28. (specialist adj3 care).tw.
29. (specialist adj3 service*).tw.
30. (specialist adj3 assessment*).tw.
31. (clinical adj3 care).tw.
32. (clinical adj3 review).tw.
33. (primary adj3 care).tw.
34. (secondary adj3 care).tw.
35. outcome assessment healthcare.tw.
36. health care.mp.
37. medic* review.mp.
38. health service provision.tw.
39. (nursing adj3 care).tw.
40. (nursing adj3 service*).tw.
41. palliative care.mp.
42. old* people*.tw.
43. old* person*.tw.
44. old* adult*.tw.
45. old* patient*.tw.
46. residents.tw.
47. elder*.tw.

48. geriatric*.mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword, floating subheading word]

49. aged.tw.

50. hospitali*ation.mp.

51. hospital admission/

52. hospitalizations.mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword, floating subheading word]

53. (acute care adj3 transfer*).mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword, floating subheading word]

54. (emergency adj3 transfer*).mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword, floating subheading word]

55. (transfer* adj2 hospital).mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword, floating subheading word]

56. place* of death.mp.

57. location of death.mp.

58. site of death.mp.

59. (died adj3 place).tw.

60. (died adj3 hospital).tw.

61. (died adj3 home).tw.

62. inpatient death*.tw.

63. end of life.tw.

64. 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16 or 17 or 18 or 19 or 20

65. 21 or 22 or 23 or 24 or 25 or 26 or 27 or 28 or 29 or 30 or 31 or 32 or 33 or 34 or 35 or 36 or 37 or 38 or 39 or 40 or 41

66. 42 or 43 or 44 or 45 or 46 or 47 or 48 or 49

67. 50 or 51 or 52 or 53 or 54 or 55 or 56 or 57 or 58 or 59 or 60 or 61 or 62 or 63

68. 64 and 65 and 66 and 67

69. limit 68 to (english language and yr="2010 -Current")

70. limit 69 to (article or article in press or review)